SECRET

No. 116

19491

Economic Intelligence Report

COMPETITIVE ASPECTS OF SOVIET AND WESTERN TRANSPORT AIRCRAFT

November 1961

CENTRAL INTELLIGENCE AGENCY
Office of Research and Reports

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FOREWORD

This report reviews the competitive aspects of Soviet and Western turbojet and turboprop transport aircraft in relation to performance, costs, utilization, facilities required for operation, and other economic factors that influence the selection of Soviet aircraft for purchase by countries outside the Sino-Soviet Bloc. In addition, such aspects as safety of operation and life of aircraft, engines, and propellers are reviewed. The report is not intended to provide a detailed study of individual aircraft but to give sufficient information to bring to light areas of advantage or disadvantage between comparable Soviet and Western transports.

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COMPETITIVE ASPECTS OF SOVIET AND WESTERN TRANSPORT AIRCRAFT*

Summary and Conclusions

In a comparison for purchase between Soviet high-performance transports and those of Western designs, several competitive aspects must be taken into account. Because the USSR usually apparently offers an attractive price to a prospective customer, the Soviet price for initial equipment probably will be lower than that of a comparable Western aircraft.**

The operational economy of the Soviet jet transports is very poor -- in fact, too poor for profitable operation by Western standards. The refueling and turnaround time for the Soviet transports, from all accounts, is excessive. The acquisition of spare parts from the USSR may be slow, although the USSR has demonstrated the capability to supply requested parts on short notice as well as to provide information and modification materials quickly. Some of the Soviet transports exhibit maintenance deficiencies, and some turboprop aircraft have had operational problems. Such factors favor the purchase of a Western transport in spite of the lower initial cost of a comparable Soviet aircraft.***

Along with operational economy the safety aspects of Soviet transport aircraft suffer by comparison with those of Western aircraft. The safety deficiencies are noteworthy on both the Soviet jet and turboprop

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* The estimates and conclusions in this report represent the best judgment of this Office as of 1 October 1961.

** When the term comparable is used, it is used advisedly, for the Soviet turbojet or turboprop airliner does possess comparable aircraft characteristics and basically similar carrying capacities. The advantages of Western transport aircraft lie in economy of operation, safety, higher rates of utilization, and -- of prime importance -- life of the aircraft and aircraft engine.

*** When a Soviet transport is offered for sale to a particular country, the various aircraft companies in the US will make available, free of charge, sales engineers to assess the Soviet offer. These sales engineers will compare the pertinent US and Soviet aircraft and will study the aircraft needs of the particular country at no charge. Furthermore, the US companies, if given the price of the Soviet aircraft offered in any particular case, will compare the operating costs of the Soviet transport and the Western aircraft.

aircraft as is evidenced by the recently publicized crashes of Camel (Tu-104) and Coot (Il-18) aircraft.* The Tu-104 apparently suffers from lift problems during takeoff and braking difficulties while landing, whereas problems with the engine and with vibration have thus far plagued the operational existence of the Il-18. Western aircraft, on the other hand, are tested at greater length and are accepted according to the international standards of airworthiness prescribed by the International Civil Aviation Organization (ICAO), an organization that the USSR does not recognize and has not joined.

According to all available information, Soviet transports are utilized far less than are comparable Western models. For example, individual US jet transports fly more during a given period of time than the combined hours of three Soviet jet transports. The vast disparity of utilization may be in part attributed to difficulties in obtaining spare parts, especially when outside the USSR, and a variety of maintenance problems that add to the ground time of the Soviet aircraft. A lack of requirements for travel also may be a major factor in the excessive grounding of the Soviet transports.

The greatest contrast between Western and Soviet transports lies in the respective guaranteed life, time to overhaul, and replacement of parts for the aircraft. Two or three Soviet engines are discarded before the guaranteed time to the first overhaul of a comparable Western propulsion system. Guarantees of propellers and parts show equal contrast. The wide discrepancy in guaranteed and actual life before scrapping of such expensive items as engines, propellers, and parts vastly increases the operational cost of the Soviet aircraft. Even should the Soviet aircraft be acquired as a gift, the costs of these replacements may make the Soviet aircraft unsatisfactory economically, especially when contrasted with comparable Western models.

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* Operational failures occur in the use of any new aircraft whether Soviet or Western. The crashes of Tu-104 aircraft, however, have been reported late in the operational life of the aircraft. The engine problems disclosed by the crashes of Il-18 aircraft were of such magnitude as to have precluded certification in the US.

I. Characteristics and Performance

A comparison of the characteristics and performance of Soviet transport aircraft with Western transports reveals few significant differences.* It should be noted, however, that the capabilities listed for Western aircraft are actual capabilities, whereas for the most part those listed for the Soviet models are based on Soviet claims or have been estimated.

There is no long-range Western transport that is closely comparable in size to the giant turboprop aircraft, the Cleat (Tu-114). Although it compares favorably with the Boeing 707-720B turbojet in both range and speed, the Tu-114 is a much heavier and larger aircraft. As to the comparable performance of the two aircraft, Western airlines prefer the frequency of flight of the 707 jet to the single long haul of the Tu-114 with a heavier load. Downtime of the Tu-114 probably is greater than that of the 707 because of difficulties with its engine reduction gears, counterrotating propellers, and landing gear. Also, the failure to obtain the Moscow-New York run, one of the few for which the Tu-114 is feasible, probably is a contributing factor to the lengthy downtime of the aircraft.

A Western turbojet transport, the French Caravelle (about 20 feet shorter than the Tu-104B), is superior in performance and passenger accommodations to many of the Soviet jet transports. The Caravelle VI carries 64 first-class or 80 tourist-class passengers, whereas the Tu-104A carries 70 tourist-class passengers. The Convair 880, also in the weight and size category of the Tu-104 series, is superior to the Soviet jet transports in speed, range, and other performance characteristics.

In shorter range jet transports, there are few Western aircraft comparable to the new Soviet Cookpot (Tu-124), which has not yet entered operational service in the USSR. The Tu-124 probably is comparable to the British BAC 111, which, like the Tu-124 has not entered airline service. The Caravelle has a higher passenger capacity, 64 to 80 persons, compared with 44 to 68 reported for the Tu-124. The estimated performance for the Tu-124 indicates that it has a cruising speed approximately 60 miles per hour (mph) faster than the series III Caravelle, but it has a shorter range. An advantage of the Tu-124 is the fact that it reportedly is fitted with wing leading edge slots for operations on short runways.

* For characteristics and performance data on the various aircraft, see Tables 5 through 10, Appendix A, pp. 19 through 24, below. For photographs of aircraft mentioned in this report, see Appendix B. For methodology, see Appendix C.

Good comparisons may be made between the Soviet medium-range turboprop transports, the Il-18 and the Cat (An-10), and the Lockheed Electra 188. The fuselage length and maximum takeoff weight of the Electra are less than those of the An-10. Although the An-10 can carry a greater payload than the Electra, it has a slower cruising speed and shorter range. The external appearance of the Electra is somewhat more refined than that of the An-10. The Il-18 is very similar to the Electra in both performance and characteristics, and few differences are noted in these turboprop transports.

Also very similar in performance are the short-range turboprop transports, the Fairchild (Fokker) F-27, built in the US under license to Fokker of the Netherlands, and the Soviet-designed Coke (An-24). The reported range of the F-27 with maximum fuel is, however, greater than that of the An-24. Furthermore, the F-27 is in airline use at present and is a proved, successful carrier, whereas the An-24 has yet to be proved in airline service.

Marked similarities also exist between Soviet and Western cargo aircraft. The Cub (An-12), an Antonov-designed turboprop transport, is essentially a military version of the An-10 with the aft fuselage modified to incorporate a cargo-loading ramp through large doors on the underside of the upswept rear fuselage. Although complete specifications and performance data on the An-12 are not available, they probably are much like the An-10. The An-12 appears to resemble very closely in performance the Lockheed C-130B. The C-160 transport to be built under the joint French-German "Transport Alliance" is not yet in production, but specifications and predicted performance indicate that it will be comparable with the An-8.

Soviet aircraft, in general, compare favorably with Western transports in the landing facilities required. The minimum takeoff field length for the turboprop Tu-114 to clear 50 feet is the same distance as is required for the Boeing 707 to break ground. The Camel series requires a long runway and in most reported cases has traveled the full length of the runway before becoming airborne. The braking action of the Tu-104 on landing is described as violent and must often be supplemented by a parachute. Closely comparable in takeoff distance required to clear 35 feet are the Lockheed Electra and the Il-18. The Electra requires 4,700 feet compared with 4,850 feet for the Il-18.

The An-10, the An-12, and the An-24 (particularly the two latter types) have a distinct advantage over Western aircraft in that they can be operated from sod fields, and they can use any hard-surfaced fields from which Western high-performance transports customarily take off with loads. These Soviet aircraft may have considerable appeal to underdeveloped countries, for such aircraft do not require the construction of expensive, long, concrete runways for operation.

It is apparent that there are few striking differences between Western transport aircraft and their Soviet-designed counterparts in either characteristics or performance. In most cases, shortcomings in one are balanced by slight comparable deficiencies in the other. The two weaknesses common to all the Soviet transports should be noted. The USSR has lost economy of operation because of the high rate of fuel consumption in engine utilization. Also, in order to maintain simplicity and ease in production, the USSR consistently produces a heavier structure than is manufactured in the West. The structural weight and fixed equipment of the Soviet transport is 10 to 15 percent heavier than the comparable Western aircraft. The operating empty weight of the Il-18 even without seats and internal starting equipment, for example, is about 23 percent greater than that of the Lockheed Electra, although the Il-18 performs about the same mission with an equal payload. 1/* A comparison of the structural weight of the Tu-104 with that of comparable Western transport aircraft is given in Table 1.

Table 1

Components of Structural Weight
of Soviet and Western Transport Aircraft as a Percentage
of Takeoff Weight a/

Percent

Aircraft	Wing	Fuselage	Tail	Landing Gear	Engine Nacelle	Total
Western						
Comet IV	11.1	7.0	1.2	3.4	0.9	23.6
Comet IVB	12.03	7.44	1.29	3.48	1.4	25.64
Boeing 707	10.1	7.4	2.04	4.33	1.63	25.5
Caravelle I	14.5	10.3	1.9	5.0	1.1	32.8
Average	11.93	8.04	1.61	4.05	1.26	26.88
Soviet						
Camel (Tu-104)	14.0	10.31	2.38	4.45	1.56	32.7

a. 2/

* For serially numbered source references, see Appendix E.

The structural weight of the Tu-104 is heavier in all respects than that of the Western transports, indicating that the Tu-104 lacks the structural efficiency of the Western transports. 3/ As a result, Soviet transport aircraft sacrifice either range or carrying capacity, a costly sacrifice for the prospective customer.

Two additional facts not evident from any comparison of data should be borne in mind: first, as previously mentioned, because some data concerning Bloc transport aircraft are based on Soviet claims, the actual capabilities may fall somewhat short of the estimates submitted; and, second, the Western transports are designed and produced according to specifications and requirements determined by the lengthy experience of airlines in hauling passengers and cargo. This invaluable experience is not available to the Soviet airline, Aeroflot. Therefore, some of the Soviet aircraft may not measure up to the intended roles prescribed for economical usage on airlines.

II. Carrying Capacity, Comfort, and Convenience

Among the most important competitive aspects of Western and Soviet transport aircraft is the passenger or cargo capacity of the aircraft. A comparison of Soviet and Western transports with regard to payload capabilities is given in Table 2.*

It is apparent from the foregoing that there are few significant differences in payload capabilities that are readily apparent when comparing Soviet and Western transport aircraft. As was the case, however, with the comparison of performance in Table 2, the figures given for Western aircraft are actual carrying capabilities, whereas those stated for the Soviet transports are those claimed by the USSR or are estimated figures.

The one outstanding exception in passenger capacity, as shown in Table 2, is the Soviet-designed Tu-114, a civil derivative of the Bear (Tu-95) heavy turboprop bomber. Clearly capable of carrying more passengers a longer distance than any Western transport, the Tu-114 does not appear a threat in terms of its being exported to foreign countries. No underdeveloped country has a land mass so great as to require such an extremely long-range transport. Even the USSR admits that the transport is not suitable for operations of less than 2,700 nautical miles nonstop, and Khrushchev himself has stated that the Tu-114 is basically a bomber and as such is unsuitable for passenger service. Furthermore, the aircraft, first shown in 1957, did not enter scheduled service in the USSR until 1961, thus indicating continued or recurrent developmental problems. Finally, it is unlikely that the Tu-114 can be used in any

* Table 2 follows on p. 7.

Table 2

Payload Capability
of Comparable Western and Soviet Transport Aircraft a/*

Class of Aircraft	Aircraft	Country of Origin	Number of Passengers	Cargo Pounds	Cargo Range in Nautical Miles	Maximum Cargo in Pounds	Range in Nautical Miles with Maximum Cargo
Long-range jet and turboprop	Boeing 707-720	US	131 to 189	19,630	5,200	40,053	4,000
	DC8-50	US	112 to 173			36,500	5,150
	Vickers Super VC-10	UK	161 to 212	33,000	4,100	58,000	3,400
	Cleat (Tu-114)	USSR	120 to 220	34,000 b/	5,400	124,000	1,700
Short-range jet	Avro 771	UK	42 to 60		1,470	12,000	435
	Hunting BAC 111	UK	59	9,800	1,300	14,000	600
	Cookpot (Tu-124)	USSR	44 to 68				810
Medium-range jet	De Havilland Comet 4C	UK	72 to 102	19,630	2,250	24,610	
	Caravelle X	France		17,640	1,850		
	Boeing 720	US	90 to 112	14,850	1,950	33,955	1,200
	Convair 880-22	US	88 to 110	23,150	2,780	26,780	
	Camel A (Tu-104A)	USSR	70	17,600 c/	2,400 d/	29,000	
	Camel B (Tu-104B)	USSR	100 d/	22,140 c/	2,300 d/	26,500	

* Footnotes for Table 2 follow on p. 8.

Table 2

Payload Capability
of Comparable Western and Soviet Transport Aircraft a/
(Continued)

Class of Aircraft	Aircraft	Country of Origin	Number of Passengers	Cargo Pounds	Cargo Range in Nautical Miles	Maximum Cargo in Pounds	Range in Nautical Miles with Maximum Cargo
Medium-range turboprop	Lockheed Electra 188	US	66 to 98	18,000	2,400	26,500	3,000
	Vickers Vanguard	UK	139	20,500	2,230	37,000	1,120
	Britannia	UK	73 to 133	23,524	4,600	34,900	3,700
	Coot (Il-18)	USSR	73 to 111	25,400	2,700	29,600 c/	1,400
	Cat (An-10 and 10A)	USSR	84 to 100	22,700	1,840	32,000	970
Short-range turboprop	Fokker F-27	US	32 to 48	5,000	1,300	8,930	677
	Handley Page Herald	UK	38	6,200	1,500	10,290	755
	Coke (An-24)	USSR	32 to 42	8,750 c/	1,000	10,000 c/	800
Turboprop cargo	Canadair CL44D5	Canada				77,392	1,900
	Short Britannic SC-5	UK		25,000	4,170	85,500	870
	Lockheed C-130B	US		22,200	3,400	36,200	1,850
	Camp (An-8)	USSR		17,000	1,445	27,000	1,200
	Cub (An-12)	USSR		22,000	1,300	33,000	480

a. For additional characteristics, see Tables 5 through 10, Appendix A, pp. 19 through 24, below.
b. With full fuel but with passenger furnishings removed.
c. With passenger furnishings removed.
d. With less than full fuel.

role other than that of an extremely long-range transport, at least in its present configuration. The small doors and extreme height from the ground preclude the aircraft from a cargo role without an extensive modification or developmental program.

There is little significant difference in passenger or cargo capacity between Western and Soviet transports (other than the Tu-114), but at least one major difference exists. The carrying capacity of Soviet transports in general is slightly reduced by the surprisingly heavy weight of the aircraft engines. The weight of the AI-20 engine, used on An-10, An-8, An-12, and Il-18 aircraft, is some 500 to 600 pounds heavier than original Western estimates. This weight for the four-engine aircraft amounts to approximately 1 ton in excess weight, thereby reducing the potential range and the potential carrying capacity.

Although less important than carrying capacity, the comfort and convenience of Soviet aircraft deserve mention. The Tu-104 aircraft, for example, are described as being very noisy and uncomfortable while taxiing. 4/ Furthermore, cabin pressurization is often erratic, and the cabin temperature has been described as never exceeding 60° Fahrenheit. 5/ Also of inconvenience and discomfort to the passenger is the fact that the passenger doors are considerably smaller than those on Western transports, thus causing the traveler to bend or lower his head when boarding or disembarking. 6/ The vibration problems of the Il-18, An-10, and Tu-114 aircraft also would detract from the comfort of the passenger.

III. Safety

Soviet transport aircraft are significantly inferior in the safety of aircraft operations than are Western models. Both Soviet jet and turboprop models suffer by comparison with Western aircraft in safety factors, as is evidenced by the large number of crashes of Tu-104 and Il-18 aircraft within the past few years. Significantly, even in the Bloc there has been dissatisfaction with the safety of the Tu-104 and Il-18 transports. 7/ East German pilots, for instance, consider the Il-18 unsafe and have stated that "it should be taken off the airways."

Three safety problems have been noted in the operation of the Camel series of turbojet transports (Tu-104, Tu-104A, and Tu-104B). 8/ First, the problem of fuel consumption, previously mentioned, is of importance. Fuel consumption appears to be 11,000 to 12,000 pounds per hour. The Soviet practice apparently is to require a fuel reserve at night. It has been reported that even in the USSR where fields are available, on Aeroflot flights the red light on the fuel gauge repeatedly indicated that the aircraft was on reserve fuel at each landing. Fuel problems

of this nature would be greatly increased in underdeveloped areas in which numerous adequate landing facilities are not available.

A second safety factor of the Tu-104 series relates to the problem of takeoff. The average time before the aircraft is airborne is approximately 50 seconds, followed by a relatively slow rate of climb to altitude for a jet aircraft. This performance is in direct contrast to the high safety standards required by the ICAO. 9/

A third safety defect involves the landing distance required for the Tu-104 series in contrast to such comparable Western transports as the Comet, the Caravelle, and the Convair 880. The stalling speed in landing configuration and the required approach speeds appear very high in the Tu-104 series, averaging 187 mph over the end of the runway and 175 mph at touchdown. The following braking action is violent, and the braking is supplemented in an emergency by a drag parachute. Because of this landing difficulty, many cases of tire failure have been reported. Numerous cases of the aircraft running beyond the runway and of brakes smoking and catching fire also have been reported. Water trucks even have been employed to wet down the tires. According to US safety standards, a runway of more than 11,500 feet is required for an aircraft with the landing weight of the Tu-104. 10/ Few such runways are available in the underdeveloped areas of the world.

Several safety deficiencies also are evident in the operation of Soviet turboprop transports, notably the Il-18. All Il-18 aircraft were grounded during 1960 following the widely publicized crashes of some of the transports during the year. The trouble at that time appeared to involve the fuel injection nozzles of the engine, which allowed the flame to burn through the engine case into the nacelle compartment where adequate fire protection was not available. 11/ Although the Il-18 aircraft are again flying, considerable skepticism toward the aircraft is still noted, and Soviet and Satellite citizens reportedly are most reluctant to travel via the Il-18.

A significant safety deficiency of Soviet turboprop transports is the comparatively lengthy time required to "feather" a malfunctioning engine. Only a few seconds lost in this operation causes multiple structural failures on the aircraft, and virtual disintegration results. Far more attention has been placed on Western transports in the solution of this problem than has been noted on the Soviet models.

The engine problems with the Il-18 transport are obviously significant. Reportedly the crash on 16 August 1960 of an Il-18 near Kiev, in which all aboard were killed, resulted from fire originating in an engine that burned off one of the wings. 12/ Because the An-10, An-8,

Il-18, and An-12 aircraft all use the same engine, the engine difficulties with the Il-18 also would apply to the other aircraft and would affect their operational safety. Along with these defects, the Il-18 reportedly has excessive vibration in the forward part of the aircraft, a serious operational safety problem.

IV. Utilization

One of the most significant comparisons of Soviet and Western transport aircraft is found in the comparative utilization of the aircraft. Soviet transports suffer by comparison with the Western transports in respect to utilization. The average revenue hours per aircraft day for US airlines and for aircraft hours flown per day by the UK and by Aeroflot, by type of aircraft, are shown in Table 3.

Table 3

Comparison of Flying Hours per Aircraft Day
of Selected US, UK, and Soviet Transports a/

US		UK		USSR	
Average Revenue Hours per Aircraft Day b/		Hours Flown per Aircraft Day		Hours Flown per Aircraft Day	
Aircraft	Hours	Aircraft	Hours	Aircraft	Hours
Boeing 707	8.7	Viscount 701	7.0	Cat (An-10)	3.0
Douglas DC 8	7.1	Comet 4	7.4	Coot (Il-18)	3.5
Lockheed Electra	7.6	Britannia 312	8.1	Camel (Tu-104)	2.5

a. The figures for US airlines include average revenue hours flown per aircraft day. An aircraft day is one on which an aircraft is owned by an airline and is assigned to a route. Total aircraft hours include all flying time -- whether revenue, nonrevenue, training, or other -- whereas average revenue hours flown per day include only time flown in revenue service. On an over-all basis, total flying time in 1960 exceeded revenue flying time by about 3 percent. Thus the average revenue hours flown per day in some instances understate the average flying time per aircraft day. The figures flown per aircraft day for UK airlines likewise apply to all days in which aircraft were flown, but no differentiation is believed to have been made between revenue and nonrevenue hours flown.

b. 13/

The USSR has not published figures on the utilization of its aircraft, and even if it had, it is doubtful whether such figures would be meaningful in terms of the actual performance of these aircraft. The only high-performance transport that has been intensively utilized is the Tu-104, although several aircraft of this model have remained in year-round inactive status. The Il-18 and the An-10, although produced in quantity, have had engine trouble and have only recently become completely operational. The Tu-114, produced in low numbers, entered regular service only in April 1961, and neither the Tu-124 nor the An-24 has entered operational service.

[illegible] transports operated by commercial airlines are each flown, on the average, a greater number of hours than were the three Soviet Tu-104's combined. Boeing 707 transports owned by one airline averaged 266 hours and 23 minutes per month each in the period between August 1958 and December 1959. 15/

It is apparent that the Soviet transports are utilized far less than are their Western counterparts. Many reports indicate that the ground time of the various Soviet transports considerably exceeds that of the Western models. A variety of causes, including difficulty in obtaining spare parts when outside the USSR, maintenance deficiencies on the aircraft, and other overhaul problems probably keep the aircraft grounded excessively. 16/

V. Cost and Economy of Operation

The USSR is reportedly flexible in the terms offered the prospective purchaser of Soviet transports. The USSR is willing to adjust the price, to offer favorable credit terms and low rates of interest, and, of considerable importance, to accept payment in kind or commodity or in the purchaser's own currency in order to make sales. Accompanying benefits, such as technical training, also may vary from purchaser to purchaser. The wide difference between the original cost of the Soviet and the US aircraft and the wide difference in financing terms should not, however, discourage the sale of Western aircraft. The difference in original price and purchase in a country's own currency is often made up by extremely high costs for spare aircraft engines and costs for spare parts purchased from the USSR.

Such was the case with one of the European Satellites, Hungary. The Hungarians were offered three Il-18 transport aircraft without cost. The aircraft were assessed at a value of 3 million rubles each. The Hungarians later learned that spare parts for the turboprop transports would cost 10 million rubles.

It is clear that in spite of the apparent difference in original cost, based on hidden charges; on acceptability to the traveling public; on ease of maintenance; and on ease of obtaining spare parts it is more economical to buy Western aircraft. Perhaps for these reasons, Communist China reportedly is negotiating for the purchase of the British Viscount rather than buying comparable transports from the USSR.

The ease of maintenance and rapid delivery of spare parts is of particular importance. US firms have offered, along with the purchase of their aircraft, complete maintenance facilities located in the purchasing nation, thus obviating the need for lengthy waits for parts and overhaul operations. 17/

Furthermore, as stated above, the USSR is not a member of ICAO. As a result, its aircraft are not manufactured and tested according to international standards of airworthiness set up by ICAO. 18/

In addition to the price of the aircraft, the economy of operation must also be considered. Operational economy of the Tu-104 series, for example, is very poor -- in fact, too poor for profitable operations by Western commercial airlines. The Tu-104 and Tu-104A apparently are too costly even by Soviet standards, and as a result the USSR developed the 100-passenger Tu-104B. The passenger load was increased, but the range of the aircraft was drastically decreased. Consequently, the operational cost of the Tu-104B is still too high, and the profit potential of the aircraft in normal air travel markets is very likely low. 19/

The fact that single point refueling has not been installed on the Tu-104 aircraft is of some importance as is the fact that the individual filler necks of the fuel tank are relatively small. The economical operation of the aircraft is thus hampered as the refueling time and the turnaround time of the aircraft are prolonged. 20/

Along with poor operational economy, Soviet aircraft purchased by non-Bloc countries have displayed operational problems of some magnitude. An-12 turboprop transports in particular have exhibited technical difficulties. Fuel tanks have burst; tires have blown out after landing on steel matting, which buckles under the weight of the aircraft; and the aircraft has exhibited handling problems.

It is therefore apparent that more than the original cost of the aircraft must be considered in evaluating the cost aspects of Western transports in comparison with transports produced by the USSR. Because the cost and inconvenience of overhaul of spare parts and engine replacements, the acquisition of spare parts, and the high operating cost of the Soviet transport must be added to the initial cost, the initial cost of the Soviet aircraft becomes less attractive in comparison with that of Western aircraft. Low initial cost is of little importance when accompanied by unsatisfactory operational performance, and indications are that airline operators using Soviet transport aircraft continue to experience the difficulties outlined above.

VI. Life of Engines, Propellers, and Parts

Another significant competitive aspect of Western and Soviet transports in which the Soviet aircraft suffers badly by comparison is the life of equipment and component parts. The life of the engine and of the propeller blades for the Soviet transports falls far short of those for comparable Western aircraft.

The estimated engine hours before major overhaul for Soviet aircraft engines average around 200 hours, and the estimated total hours of Soviet engine life before discarding the engine average only 800 hours. By comparison, the engine hours to first overhaul for Western aircraft engines average 1,000 to 1,800 hours. A comparison of Western and Soviet overhaul time and total life is shown in Table 4.*

The life of Soviet propellers, like that of the engines, compares very unfavorably with the life of Western counterparts. The estimated life of a propeller blade for the Soviet turboprop engine, other than for the An-24, is only 300 hours, and that of the An-24 is an estimated 600 hours. The comparable life for the Western propeller is 2,500 hours, although a regulator plate must be checked at 1,250 hours.

In addition to the very short overhaul time and total life of aircraft engines and propellers, many other parts on the Soviet transport

* Table 4 follows on p. 19.

Table 4

Comparison of Data on Overhaul and Total Life
of Western and Soviet Aircraft Engines

Soviet Aircraft Engines			Western Aircraft Engines		
Engine	Engine Hours to Major Overhaul	Engine Hours of Total Life	Engine	Engine Hours to Major Overhaul	Engine Hours of Total Life
RD-3M	200	800	Pratt and Whitney JT-3 and JT-4	1,200 to 1,800	Indefinite a/
AI-20	200	800	Allison-D501	1,000 b/	Indefinite
NK-12	200	800	Conway	1,200 to 1,800	Indefinite

a. The producer gives no fixed time before scrapping the engine. The engine can undergo an indefinite number of overhauls, each of which prolongs its life. Although no figure can be established, the life should be prolonged to more than 5,000 hours and may run as high as 8,000 hours after overhaul.
b. The Federal Aviation Agency requires an overhaul at 1,000 hours, although the producer believes that 1,800 hours of operation is safe before an overhaul is required.

are changed frequently.* Information reveals that the components on the Soviet transports frequently fail long before the guaranteed time has elapsed. An example of such Soviet equipment that is subject to failure long before the guaranteed date is the TsN-1K fuel pump. 22/ One such pump was replaced four times on one aircraft within 2 months, and a second on another aircraft was replaced five times within 4 months, in spite of the guaranteed life of the pump of 300 hours. 23/ Obviously, the high rate of replacement will ground the aircraft for extended periods should the purchaser have to obtain the parts from the USSR. US airlines could not accept the short guaranteed life of parts and the high rate of replacement of these components.

The great difference in the life of the Soviet transports and that of transports designed and produced in the West is emphasized in many reports. For instance, Ghana Airways has changed its scheduled flight from Khartoum to Accra to bimonthly rather than weekly because the AI-20 engines used in the Il-18 have a very high rate of failure in the heat at Khartoum. In addition, when President Touré of Guinea visited Khartoum enroute from Cairo, the Il-18 on which he was riding had three engines fail when preparing for takeoff in the afternoon heat. It was necessary for the Il-18 to remain in Khartoum until late in the evening so that a successful takeoff could be made. 24/

Even Bloc countries are reluctant to accept the Soviet aircraft, primarily because of the high cost of frequent replacement of engines and parts. Officials of the Polish Airlines (LOT) were reluctant to accept Il-18 aircraft in 1960 because of the necessary replacement of parts after only 250 hours of flying time. The Poles, in fact, described the Il-18 as "no good" because the operation of the aircraft was so expensive. 25/

It is apparent that the Soviet transports have a far shorter life as regards overhaul and replacement of engines and components than do comparable Western models. The cost of these frequent overhauls and early scrapping of engines and parts renders the Soviet transport aircraft economically unsatisfactory, even if acquired at a very low initial cost or in the nation's own currency when compared with a comparable Western transport. Of equal significance for the purchaser, the aircraft probably remains grounded an extended period while awaiting shipment of the part from the USSR. 26/

* For data on change and replacement as indicated from the logbooks of Camel transport aircraft, see Table 11, p. 25, below.

APPENDIX A

STATISTICAL TABLES

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Table 5

Specifications
of Comparable Western and Soviet Long-Range Jet and Turboprop Transport Aircraft

Item	Unit of Measure	Western Aircraft						Soviet Aircraft
		Boeing		Douglas		Vickers		Tupolev
Aircraft		707-320	707-720	DC8-40	DC8-50	VC-10	Super VC-10	Cleat (Tu-114)
Engine		P and W JT4A-9	R-R Conway MK 508	R-R Conway RC 12	P and W JT3D-3	R-R Conway RCO/42/2 MK 540	RCO/42/4	NK-12
Number of engines		4	4	4	4	4	4	4
Thrust	Pounds	16,800	17,500	17,800	18,000	20,250	21,825	12,500
Maximum weight	Pounds	311,000	311,000	310,000	310,000	301,000	347,000	352,000
Landing weight	Pounds	207,000	207,000	199,500	199,500	197,500	241,000	283,400
Weight with zero fuel	Pounds	190,000	190,000			176,500	219,000	206,000
Operational weight empty	Pounds	132,924	131,244	124,369	124,529	134,200		186,750
Maximum fuel	US gallons	23,812	23,812	23,079	23,079	20,700	22,500	23,000
Wing area	Square feet	2,892	2,892	2,773	2,773	2,800	2,800	3,470
Span	Feet and inches	142'-5"	142'-5"	142'-5"	142'-5"	140'	146'	168'
Length	Feet and inches	152'-11"	152'-11"	150'-6"	150'-6"	158'-10"	186'	174'
Height	Feet and inches	41'-8"	41'-8"	42'-4"	42'-4"	39'-1-1/2"	39'-6"	42'
Wing loading	Pounds per square foot	107	107	111.8	111.8	106.9		108
Weight-to-thrust ratio		4.63	4.43			3.7		7.2
Cabin length	Feet and inches	111'-6"	111'-6"	102'-1"	102'-1"	91'-4"	118'	154'-2"
Cabin width	Feet and inches	11'-7"	11'-7"	11'-6"	11'-6"	11'-6"	11'-6"	12'
Cabin height	Feet and inches	7'-7"	7'-7"	7'-3"	7'-3"	7'-6"	7'-6"	7'
Cabin volume	Cubic feet	8,150	8,150					16,420
Payload								
Passengers		131 to 189	131 to 189	112 to 173	112 to 173	150	161 to 212	120 to 220
Cargo	Pounds	17,930	19,630			24,500	33,000	34,000 a/
Maximum cargo	Pounds	40,053	40,053	36,500	36,500	38,000	58,000	124,000
Cargo range	Nautical miles	5,200	5,200			5,600	4,100	5,400
Maximum cargo range	Nautical miles	4,000	4,000	4,700	5,150	4,700	3,400	1,700
Cruising speed	Knots	522	522	510	510	480	475	415

a. With full fuel but with passenger furnishings removed.

Table 6

Specifications
of Comparable Western and Soviet Short-Range Jet Transport Aircraft

Item	Unit of Measure	Western Aircraft			Soviet Aircraft
					Tupolev
Aircraft		Avro 771	Hunting BAC 107	BAC 111 a/	Cookpot (Tu-124)
Engine		Bristol BS 75	Bristol BS 75	Rolls Royce RB 163-1	Solov'yev
Number of engines		2	2	2	2
Thrust	Pounds	7,350	7,350	9,850	
Maximum weight	Pounds	52,000	48,500	66,300	
Landing weight	Pounds	50,000	46,000	62,500	
Weight with zero fuel	Pounds			56,000	
Maximum fuel	US gallons	2,400	2,680	2,702	
Wing area	Square feet	800	825	980	
Span	Feet and inches	77'-5-1/2"	81'-8"	88'-6"	
Length	Feet and inches	80'-4-1/2"	84'	94'	
Wing loading	Pounds per square foot	65	59	67.7	
Weight-to-thrust ratio		3.54	3.3	3.36	
Cabin length	Feet and inches			44'-6"	
Cabin width	Feet and inches	9'-9"	10'	10'-4-1/2"	
Cabin height	Feet and inches			6'-6"	
Payload					
Passengers		42 to 60	50 to 59	59	44 to 68
Cargo	Pounds			9,800	
Maximum	Pounds	12,000	12,000	14,000	
Cargo range	Nautical miles	1,470	2,500	1,300	
Maximum cargo range	Nautical miles	435	950	600	810
Cruising speed	Knots	495	440	435	480

a. Aircraft not available until 1963.

Table 7

Specifications of Comparable Western and Soviet Medium-Range Jet Transport Aircraft

Item	Unit of Measure	Western Aircraft								Soviet Aircraft	
		De Havilland		Caravelle			Boeing		Convair	Tupolev	
Aircraft		Comet 4C	Trident OH-121	VI	VII	X	727	720	880-22	Camel A (Tu-104A)	Camel B (Tu-104B)
Engine		Avon RA 29 MK 525	RR RB 163	Avon RA 29 MK 531	GE CJ805-23C	P and W JT8D-1	P and W JT8D-1	P and W JT3C-7	GE CJ805-35	RD-3M	RD-3M
Number of engines		4	3	2	2	2	3	4	4	2	2
Thrust	Pounds	10,500	12,260	10,500	16,100	14,000	14,000	12,000	11,200	19,800	19,800
Maximum weight	Pounds	162,000	105,000	103,620	114,640		142,000	186,000	190,000	164,000	167,000
Landing weight	Pounds	120,000	100,000	98,655	109,130		131,000	175,000	145,000	141,100	141,100
Weight with zero fuel	Pounds	102,500	85,000	78,265				142,000	120,000		
Operational weight empty	Pounds	75,085	63,200	52,910				105,000		90,865	95,000
Maximum fuel	US gallons	10,700	4,600	4,900	4,070		7,350	9,232	10,770	8,700	8,700
Wing area	Square feet	2,121	1,350	1,579	1,579	1,579	1,650	2,433	2,000	1,990	2,100
Span	Feet and inches	114'-10"	89'-10"	112'-6"	112'-6"	112'-6"	108'	130'-10"	120'	112'-7"	112'-7"
Length	Feet and inches	111'-6"	114'-9"	105'	108'-8"		134'-1"	136'-2"	129'-4"	124'	128'
Height	Feet and inches	29'-6"	27'	28'-7"				41'-6"	36'-4"	37'-8"	37'-8"
Wing loading	Pounds per square foot	76.4	77.8	65.5				76	95	82.5	84
Weight-to-thrust ratio		3.86	2.87	4.95				3.85	4.25	4.15	4.2
Cabin length	Feet and inches	78'-3"						96'-6"	89'-3"		
Cabin width	Feet and inches	9'-8"							10'-8"	10'-6"	10'-6"
Cabin height	Feet and inches	6'-6"							7'-1"	6'-11"	6'-11"
Cabin volume	Cubic feet									5,650	5,900
Payload											
Passengers		72 to 102	75 to 94	64 to 80	68 to 89		70 to 114	90 to 112	88 to 110	70	100 a/
Cargo	Pounds	19,630			17,640	17,640		14,850	23,150	17,600 b/	22,140 b/
Maximum cargo	Pounds	24,610	21,500	18,453	19,840		24,000	33,955	26,780	29,000	26,500
Cargo range	Nautical miles	2,250	1,560		1,850	1,850		1,950	2,780	2,400 a/	2,300 a/
Maximum cargo range	Nautical miles		610	1,440				1,200			
Cruising speed	Knots	435	510	430	460	450	520	525	530	460	460

a. With less than full fuel.
b. With passenger furnishings removed.

Table 8

Specifications
of Comparable Western and Soviet Medium-Range Turboprop Transports

Item	Unit of Measure	Western Aircraft				Soviet Aircraft	
		Lockheed	Vickers		Britannia	Il'yushin	Antonov
Aircraft		Electra 188	Vanguard 953	Viscount 810	Series 300	Coot (Il-18)	Cat (An-10A)
Engine		Allison 501-D13A	RR TYNE MK 512	RR DART MK 525	Bristol Protius 765	AI-20	AI-20
Number of engines		4	4	4	4	4	4
Horsepower		4,050	5,050	1,990	4,445	4,000	4,000
Maximum weight	Pounds	116,000	146,000	72,500	185,000	134,000	119,000
Landing weight	Pounds	96,000	120,000	64,000	147,000	112,000	110,000
Weight with max fuel	Pounds	80,000	105,000	57,500	138,000		
Operational weight empty	Pounds	56,000	83,500	41,965	93,100	69,000 a/	82,000
Maximum fuel	US gallons	5,520	6,160	2,280	10,300	6,250	3,980
Wing area	Square feet	1,300	1,529	963	2,070	1,500	1,300
Span	Feet and inches	99'	118'	93'-8-1/2"	142'-3-1/2"	123'	124'-5"
Length	Feet and inches	104'-6-1/2"	122'-10.4"	85'-8"	124'-3"	118'	121'-6"
Height	Feet and inches	32'-1"	34'-11"	26'-9"	37'-6"	33'-4"	32'-1"
Wing loading	Pounds per square foot	89	96	75.4	89.5	89	88
Power loading ratio		7.16	6.6	9.11	10.4	8.4	7.2
Cabin length	Feet and inches		90'-10"				67'
Cabin width	Feet and inches		10'-8-1/2"			10'-6"	12'-6"
Cabin height	Feet and inches		6'-10-1/2"			6'-6"	8'-6"
Cabin volume	Cubic feet			2,800			
Payload							
Passengers		66 to 98	139	73	73 to 133	73 to 111	84 to 100
Cargo	Pounds	18,000	20,160	14,300	23,520	25,400	22,700
Maximum range	Pounds	34,500	37,000	14,500	34,900	29,600 b/	32,000
Cargo range	Nautical miles	2,860	2,230	1,530	4,000	2,760	1,840
Maximum cargo range	Nautical miles	2,850	1,120	1,430	3,700	1,430	970
Cruising speed	Knots	352	365	310	310	342	335

a. With passenger furnishings removed and without internal starting equipment. The weight is 73,000 pounds when fitted for 84 passengers.
b. With passenger furnishings removed.

Table 9

Specifications
of Comparable Western and Soviet Short-Range Turboprop Transports

Item	Unit of Measure	Western Aircraft						Soviet Aircraft
		Fairchild	Fokker	Handley Page	Avro	Canadair	Japan	Antonov
Aircraft		F-27	F-27	Herald	748	540A	NAMC YS-11	Coke (An-24)
Engine		RR Dart RDa 7 MK 528	RR Dart RDa 7 MK 528	RR Dart RDa 7 MK 527	RR Dart DDa 7 MK 531	Eland NEI 6 K504A	RR Dart RDa 1011 MK P542	AI
Number of engines		2	2	2	2	2	2	2
[illegible]		2,105	2,105	2,105	2,105	3,500	3,060	2,000
Maximum [illegible]	Pounds	[illegible]	37,500	39,500	36,000	53,200	50,265	39,000
[illegible]	Pounds	[illegible]	35,700	38,900	35,500	50,670	48,060	
Weight with [illegible] fuel	Pounds			36,000	36,300		44,090	
Permissible weight [illegible]	Pounds	[illegible]	23,109	[illegible]	20,384	22,333	20,760	
Maximum fuel	U.S. gallons	1,360	1,305	1,300	1,370	2,580	1,850	1,000
Wing area	Square feet	754	754	886	749.9	963.8	1,024.4	760
Span	Feet and inches	95'-2"	95'-2"	94'-9-1/2"	95'	105'-4"	105'	95'
Length	Feet and inches	77'-1-1/2"	77'-1-1/2"	71'-11"	67'	81'-4"	86'-3-1/2"	74'-6"
Height	Feet and inches	27'-6"	27'-6"	25'-6"	24'-10"	28'-2"	30'	
Wing loading	Pounds per square foot	[illegible]	49.8	43	49	55.1	49.30	51.4
Power loading ratio		8.93	8.93	9.28	8.56	7.6	8.2	9.7
Cabin length	Feet and inches							42'
Cabin width	Feet and inches							8'
Cabin height	Feet and inches							6'
Payload								
Passengers		[illegible]	36 to 48	50	48 to 44	48 to 52	52 to 60	32 to 42
Cargo	Pounds		5,000	5,000	5,756	4,117	5,620	8,750 a/
Maximum cargo	Pounds		8,950	10,290	9,666	8,137	12,125	10,000 a/
Cargo range	Nautical miles	1,300	1,300	1,500	1,700	1,975	1,280	1,000
Maximum cargo range	Nautical miles		977	755	1,070	1,100	346	800
Cruising speed	Knots	280	266	243	252	280	250	280

a. With passenger furnishings removed.

Table 10

Specifications of Comparable Western and Soviet Cargo Aircraft

Item	Unit of Measure	Western Aircraft						Soviet Aircraft	
		Canadair			Short Britannic	Lockheed		Antonov	
Aircraft		CL44D4	CL44D5	CL44D6 a/	SC-5 b/	C-130B	C-130A	Camp (An-8)	Cub (An-12)
Engine		RR TYNE RTy-12	RR TYNE RTy-12	RR TYNE Stage IV	RR TYNE RTy 12	Allison T56-A7A	Allison T56-A7A	AI-20	AI-20
Number of engines		4	4	4	4	4	4	2	4
Horsepower		5,730	5,730	6,445	5,730	4,050	4,050	4,000	4,000
Maximum weight	Pounds	205,000	205,000	225,000	218,000	135,000	124,200	88,000	130,000
Landing weight	Pounds	165,000	175,000	175,000	205,000	135,000	124,200	67,000	
Weight with zero fuel	Pounds	155,000	165,000	165,000	196,000				
Operational weight empty	Pounds	88,872	87,608	88,042	107,185	69,300	59,400		
Maximum fuel	US gallons	12,200	12,200	12,200	12,200	6,960	6,960	16,000	39,800
Wing area	Square feet	2,075	2,075	2,075	2,466	1,745	1,745	1,300	1,300
Span	Feet and inches	142'-3-1/2"	142'-3-1/2"	142-3-1/2"	158'-9-1/2"	132'-7"	132'-7"	124'-8"	124'-8"
Length	Feet and inches	136'-8"	136'-8"	136'-8"	136'-5"	97'-8"	97'-8"	103'-2"	109'
Height	Feet and inches	38'-8"	38'-7"	38'-7"	47'	38'	38'	36'	32'-5"
Wing loading	Pounds per square foot	99	99	108.5	88.4	77.3	71.3		
Power loading ratio		8.95	8.95	8.75	9.5	8.3	7.7		
Cabin length	Feet and inches	98'-7"	98'-7"	98'-7"	84'-4"	41'-5"	41'-5"	40'	52'-6"
Cabin width	Feet and inches	11'	11'	11'	16'-1"	10'	10'	11'	9'-6"
Cabin height	Feet and inches	9'-9"	9'-9"	9'-9"	13'-9"	9'-1"	9'-1"	10'	9'-6"
Cabin volume	Cubic feet	6,380	6,380	6,380	11,750	4,300	4,300	3,900	
Payload									
Cargo	Pounds				25,000	22,200	29,200	17,000	22,000
Maximum cargo	Pounds	66,128	77,392	78,958	85,500	35,200	38,800	27,000	33,000
Cargo range	Nautical miles				4,170	3,400	2,520	1,445	1,300
Maximum cargo range	Nautical miles	2,640	1,900	2,900	870	1,850	1,700	1,200	480
Cruising speed	Knots	342	348	353	340	320	292	275	300

a. Aircraft available in 1962.
b. Aircraft available in 1964.

Table 11

Summary of Replacement Data for Frequently Changed Items
Camel (Tu-104A)

Nomenclature	Type	Guarantee	Number of Changes	Shortest and Longest Period of Operation	Average Operational Use
Air compressor	AK-150N	300 hours or 3 years	14	12 hours/439 hours	250 hours
Wheel, braked with a 115 x 330v tire	KT-16/2	10 landings with 9,300 kilograms a/ 80 landings with 8,100 kilograms a/	34	7 landings/119 landings	49 landings
Pump, centrifugal	ETsN-T	250 hours or 3 years	17	11 hours/600 hours	482 hours
Engine, jet	RD-3M	200 hours	14	11 hours/400 hours	279 hours
Transmitter, inertial	GA-15/5	150 landings or 3 years	17	29 landings/150 landings	76 landings
Radar, mapping	RBP-4	1,000 hours	3	31 hours/154 hours	97 hours
Pump, hydraulic	435 VF	300 hours	3	204 hours/393 hours	328 hours
Pump, engine	TsK-1K	300 hours	9	5 hours/165 hours	78 hours
Pump, engine	TsN-1D	300 hours	4	99 hours/103 hours	101 hours
Generator	GSR-18000D	400 hours	14	11 hours/395 hours	330 hours

a. Payload weight. the aircraft usually carries a payload of less than 8,100 kilograms.

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APPENDIX B

PHOTOGRAPHS OF AIRCRAFT

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Long-Range Jet and Turboprop Transports

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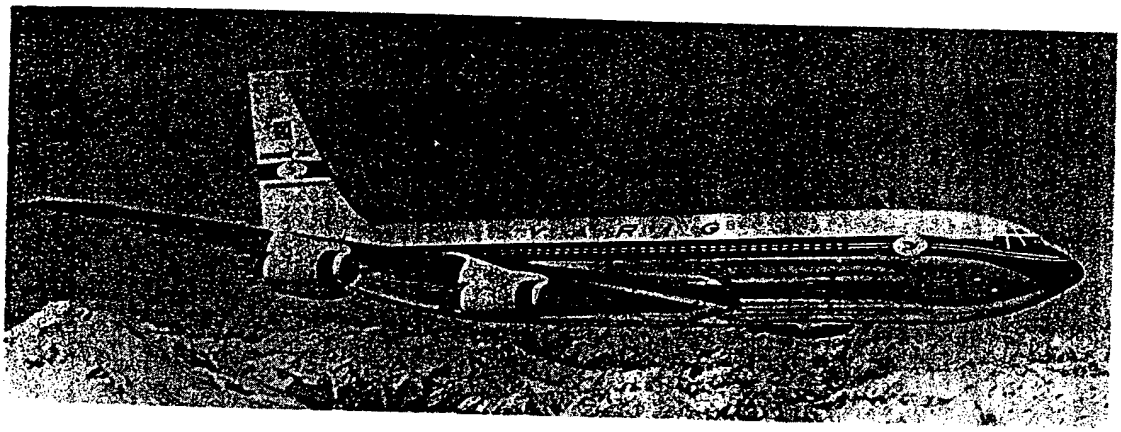
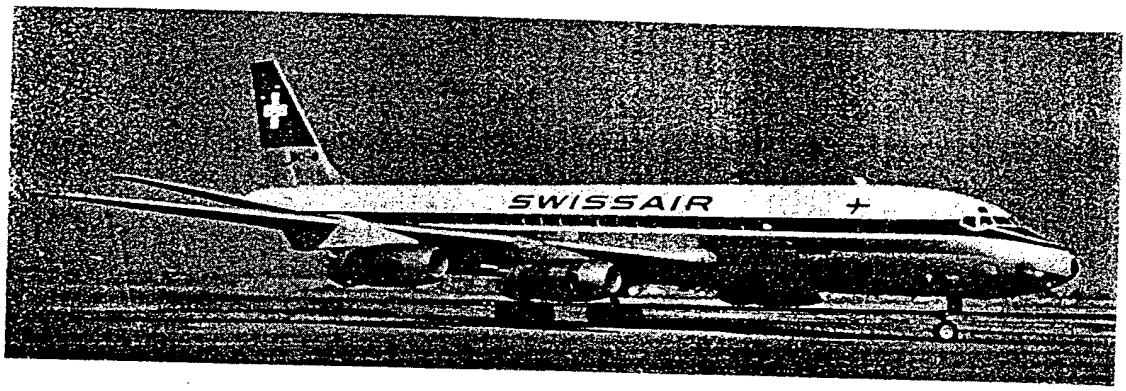


US: Boeing 707-441



US: DC-8

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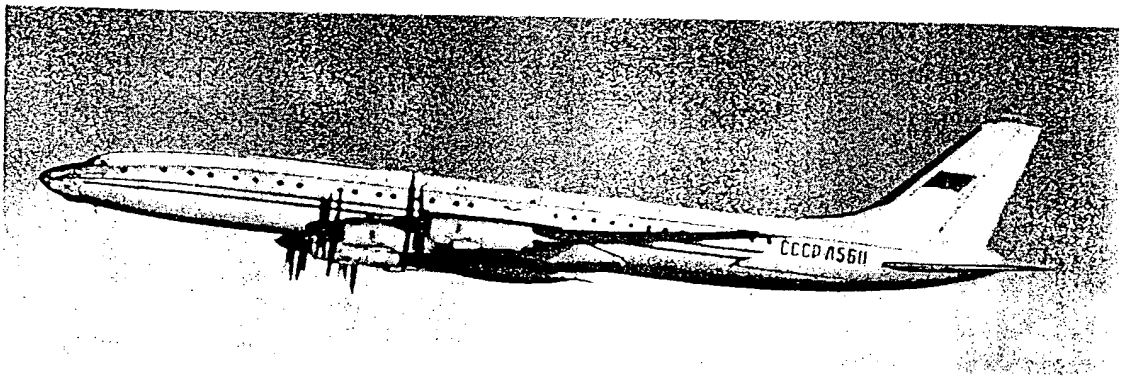
UK: Vickers Super VC-10



USSR: Cleat (Tu-114)

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Short-Range Jet Transports

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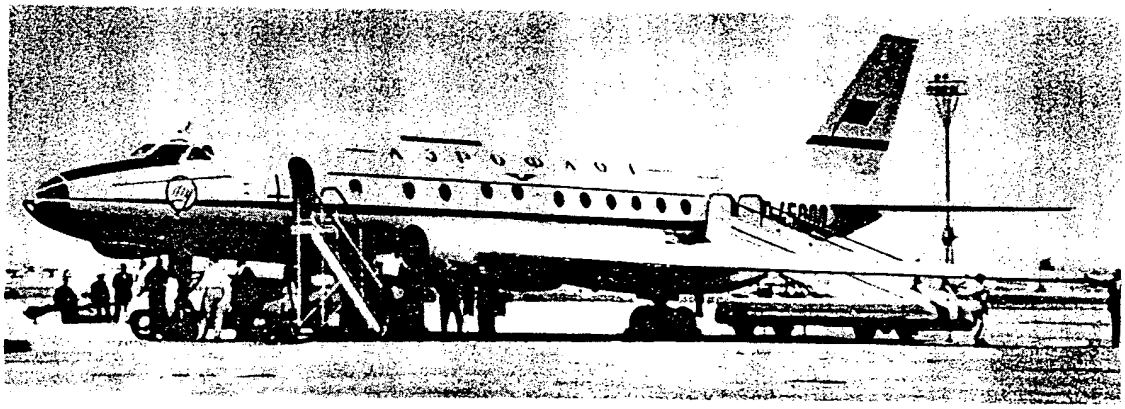
UK: Hunting BAC 111



USSR: Cookpot (Tu-124)

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Medium-Range Jet Transports

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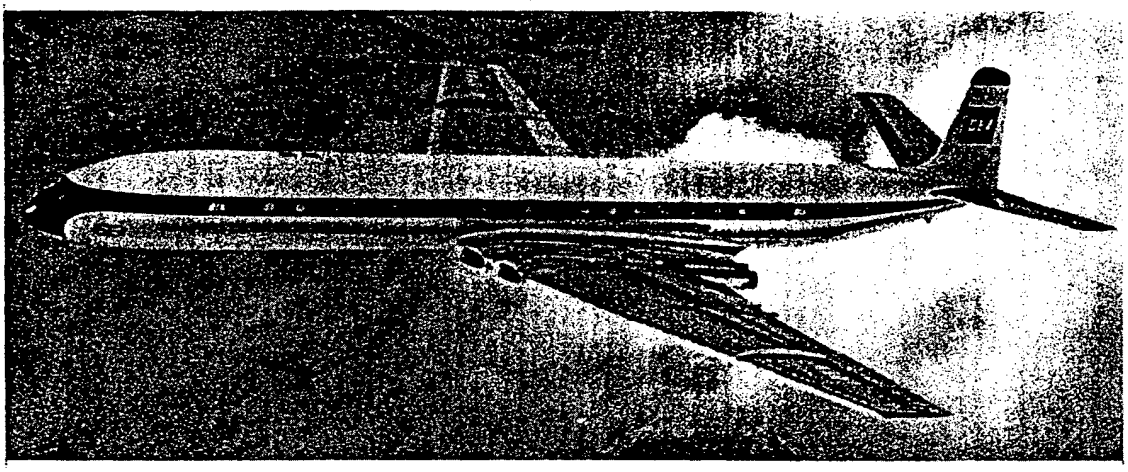
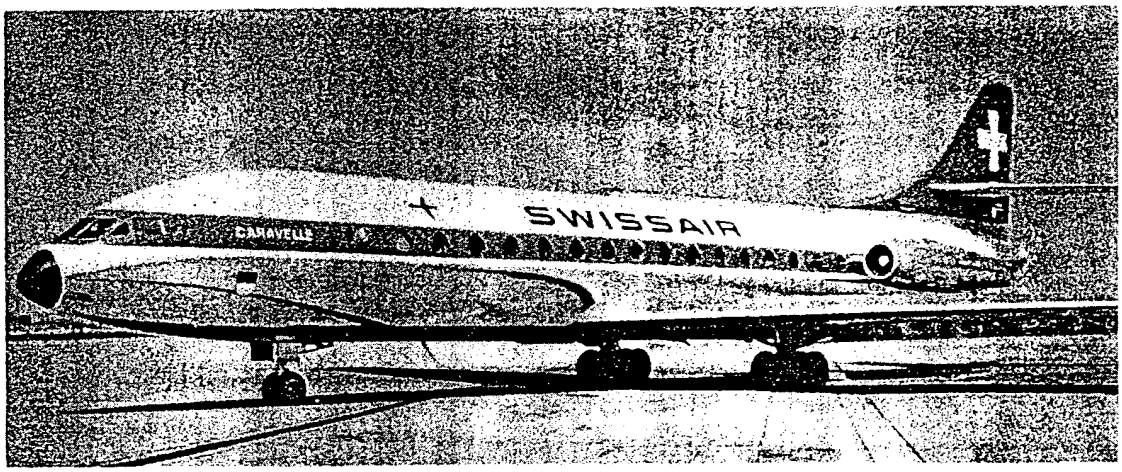


UK: De Havilland Comet



France: Caravelle

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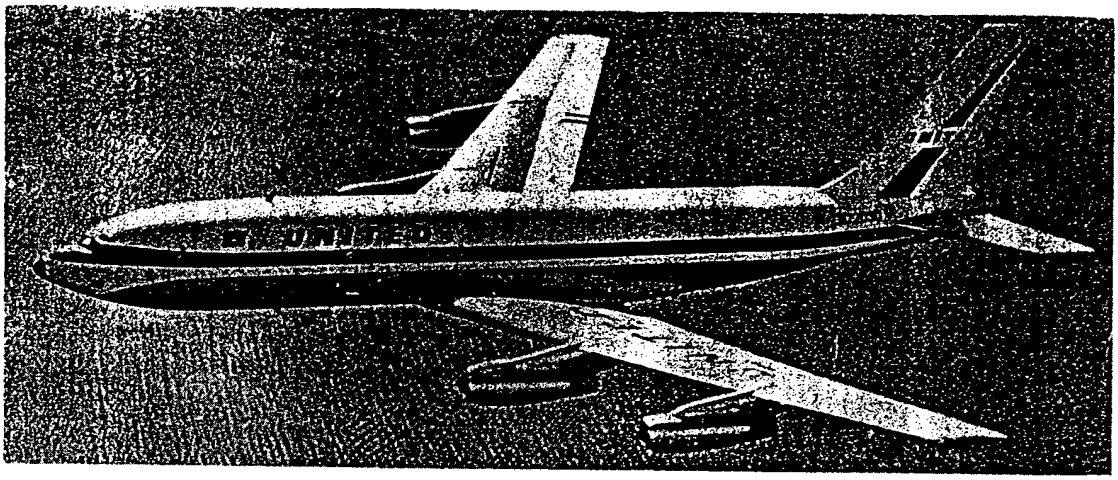
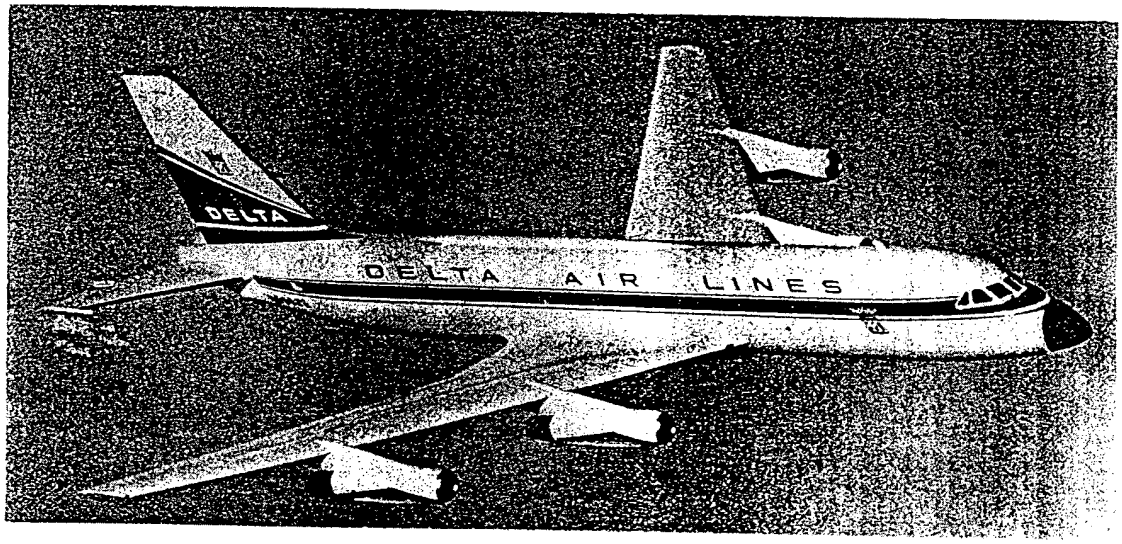


US: Boeing 720



US: Convair 880

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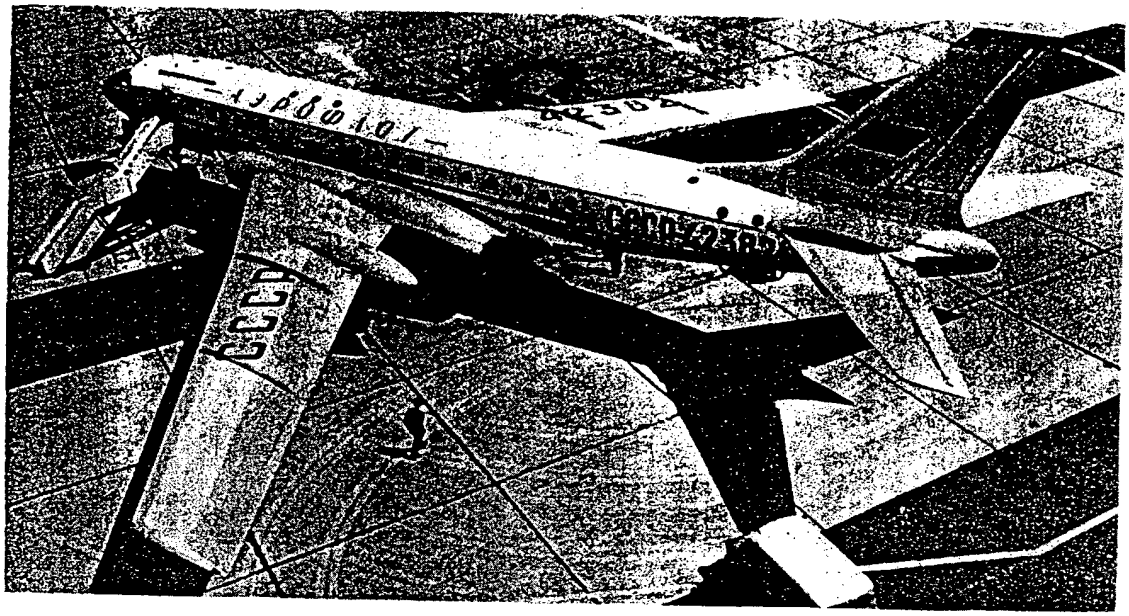

USSR: Camel A (Tu-104A)

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Medium-Range Turboprop Transports

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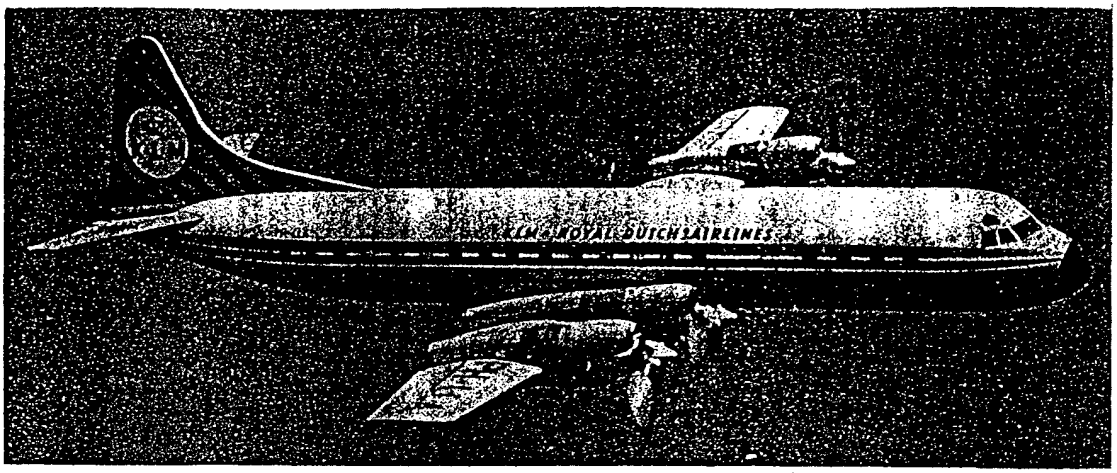
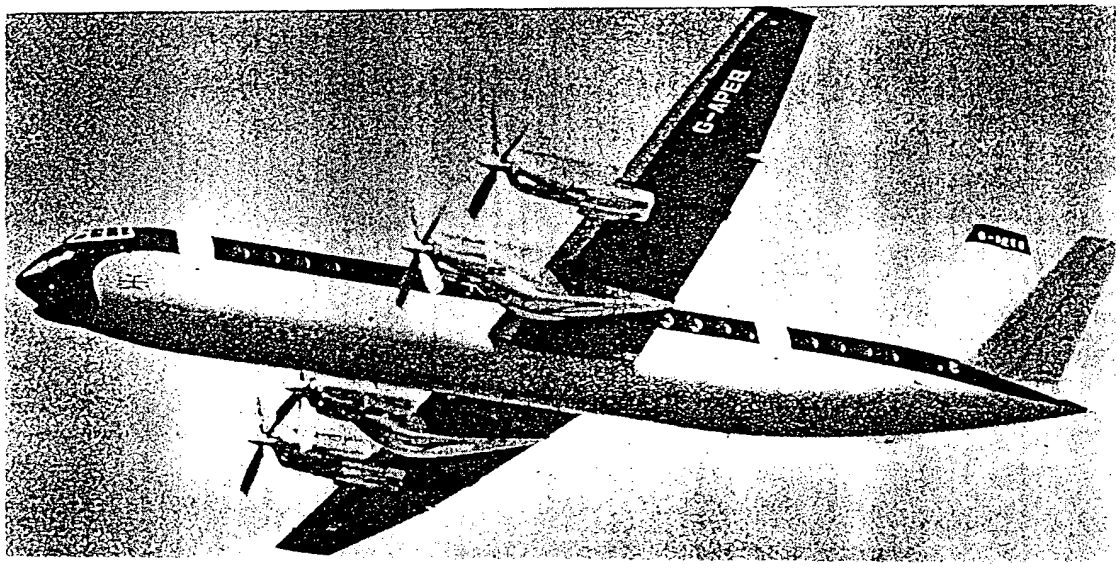


US: Lockheed Electra 188



UK: Vickers Vanguard

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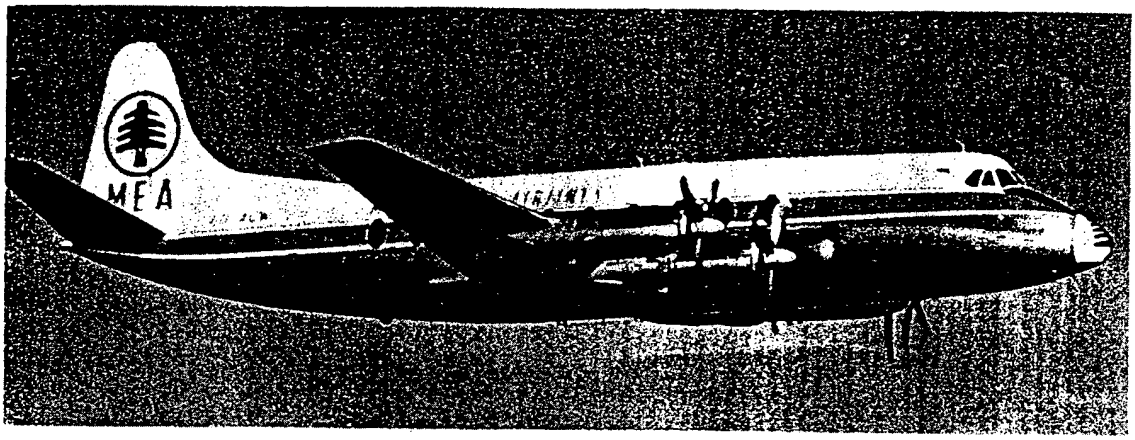
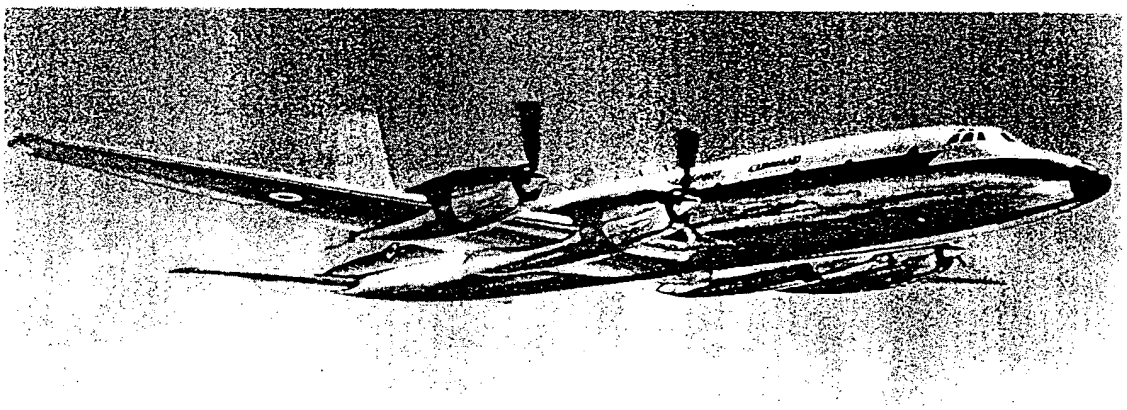


UK: Vickers Viscount



UK: Britannia

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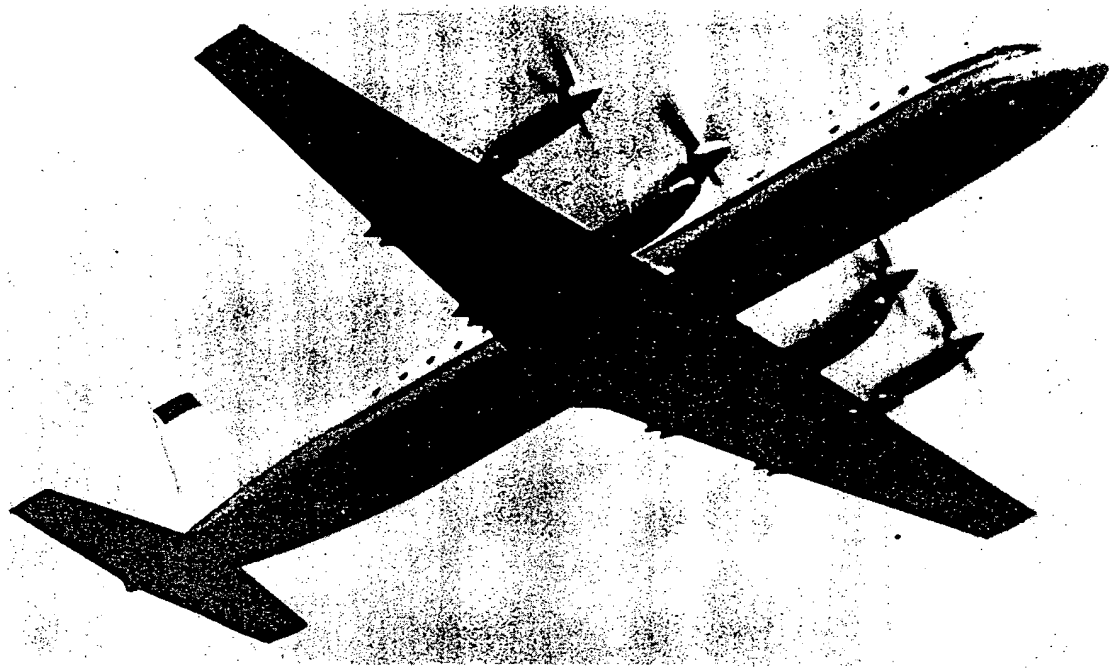

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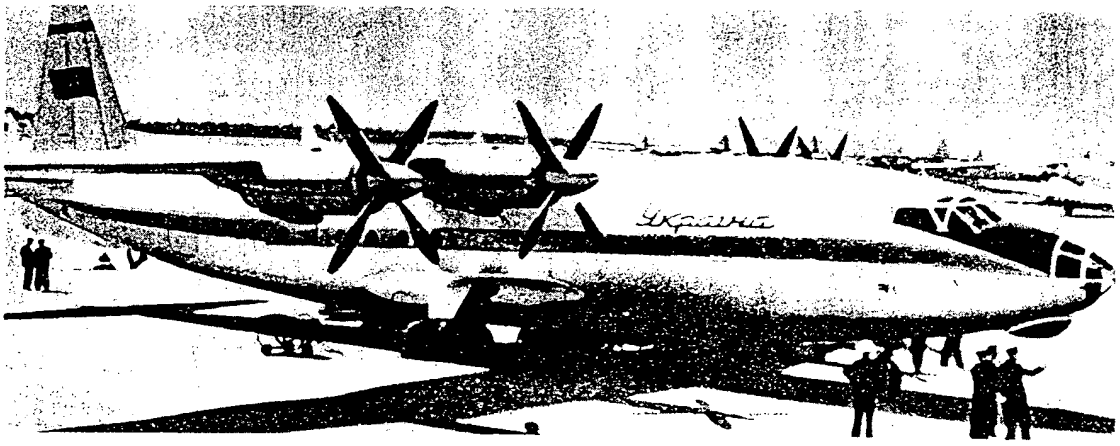

USSR: Cat (An-10)

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Short-Range Turboprop Transport

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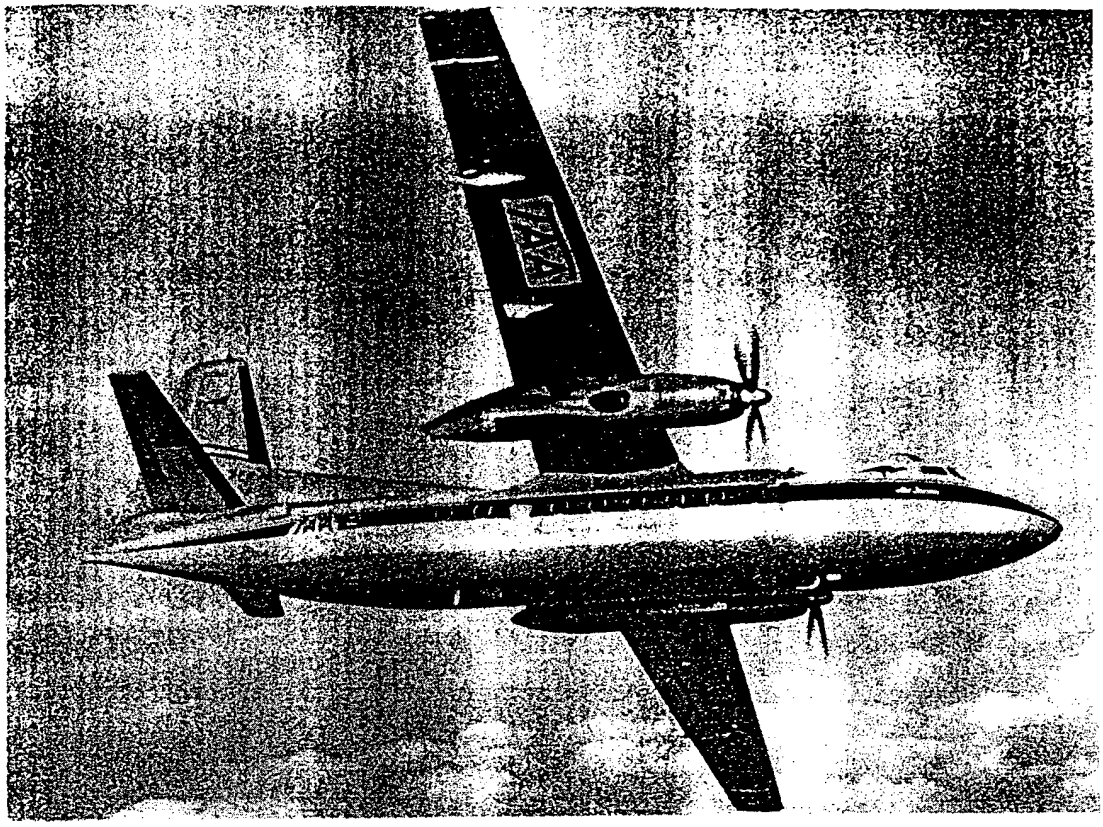
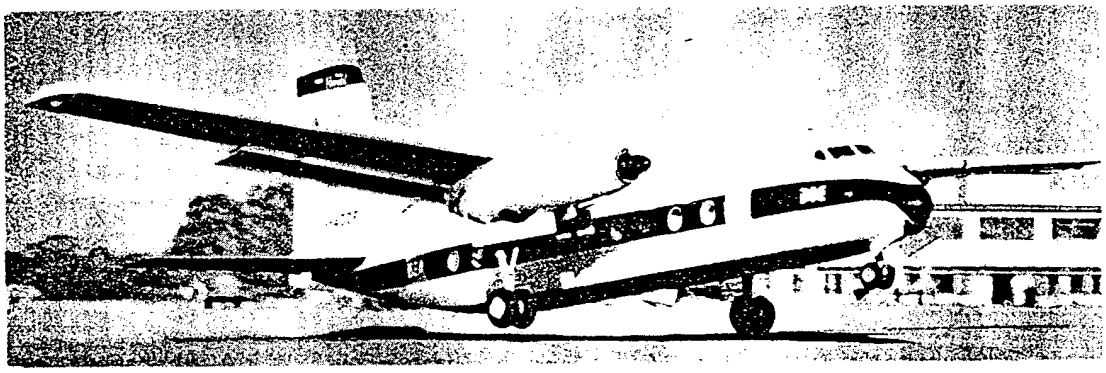


US: Fokker F-27



UK: Handley Page Herald

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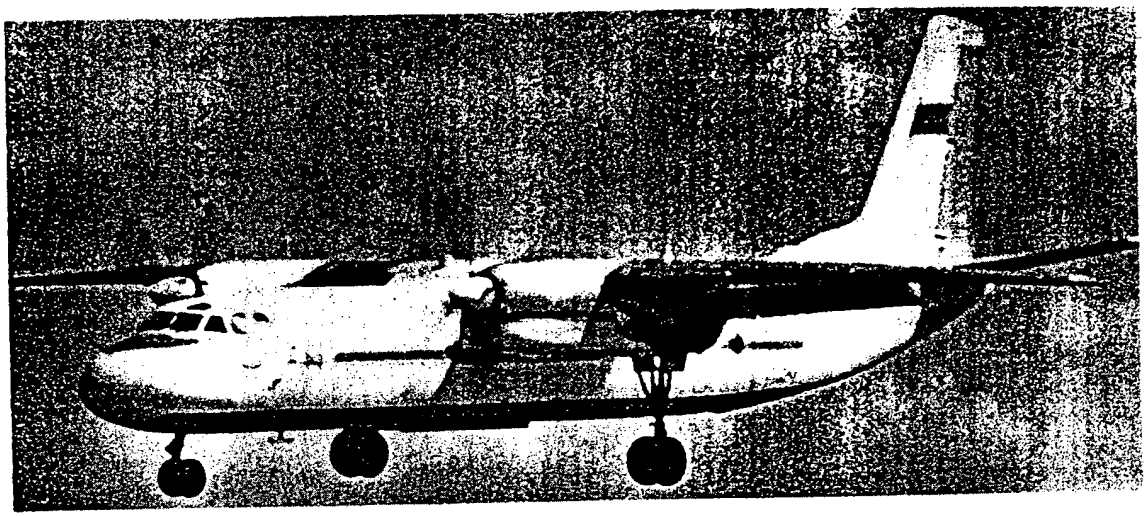

USSR: Coke (An-24)

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Turboprop Cargo Aircraft

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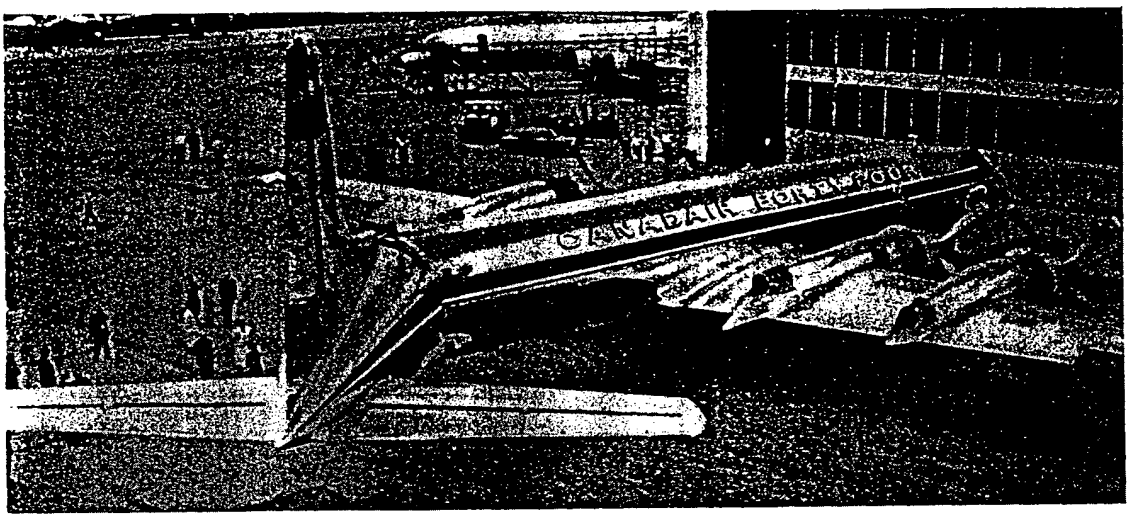
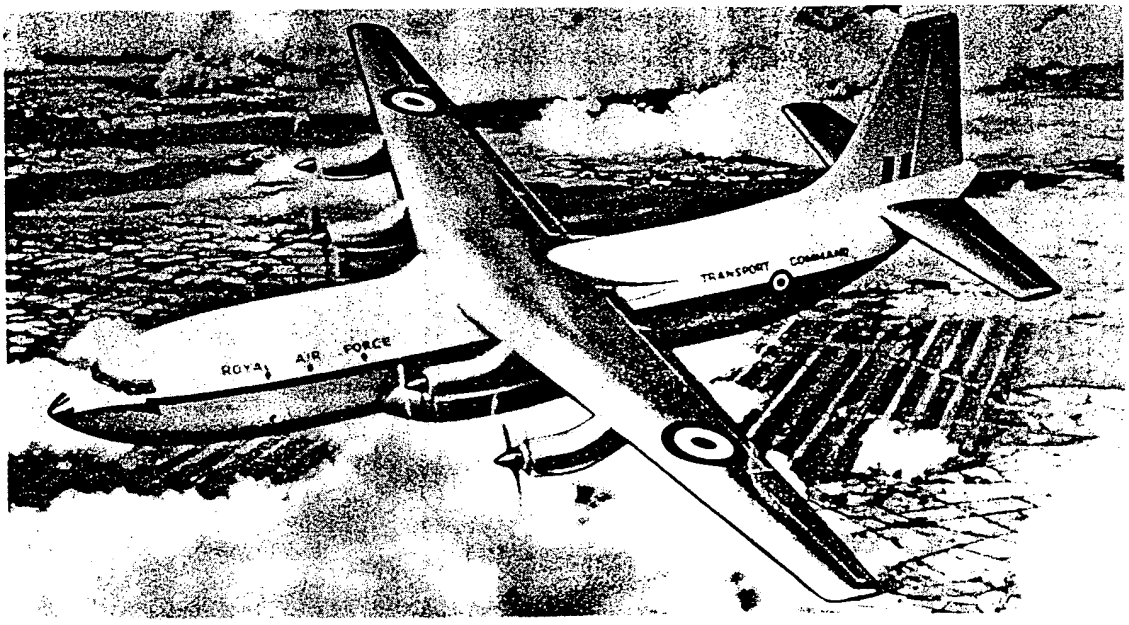


Canada: Canadair CL-44D5



UK: Short Britannic SC-5

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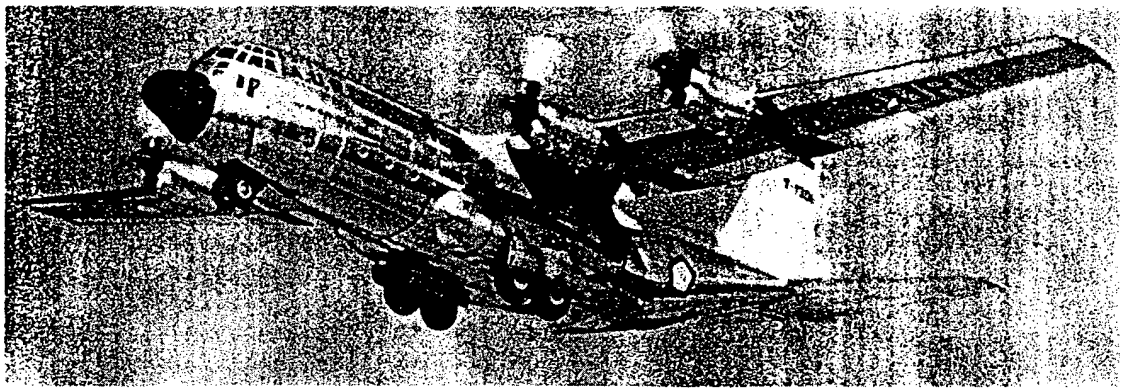
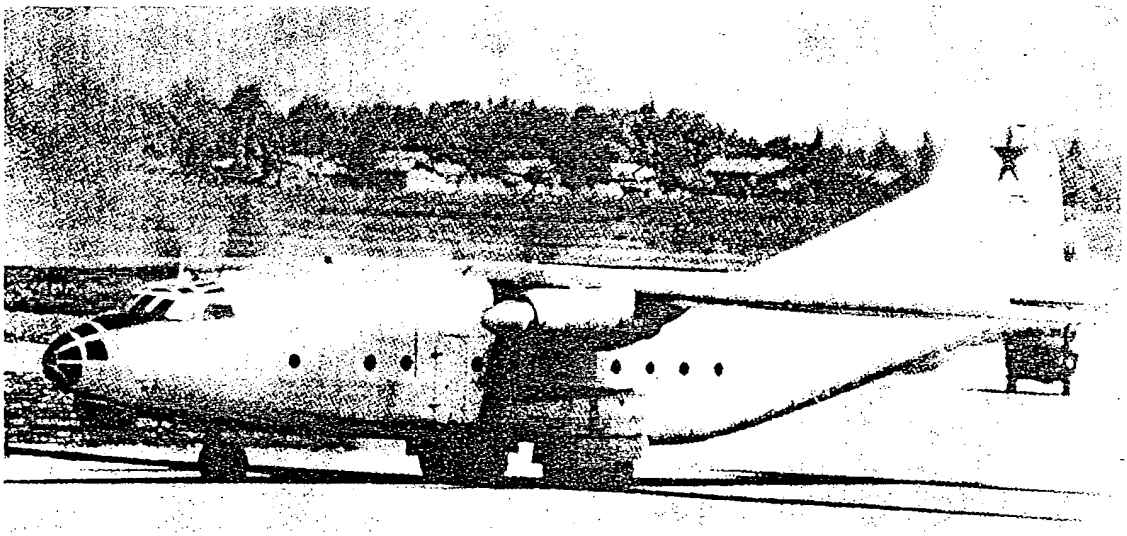


US: Lockheed C-130B



USSR: Camp (An-8)

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USSR: Cub (An-12)

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APPENDIX C

METHODOLOGY

Statements concerning the safety, comfort, and convenience of Soviet transports as opposed to Western transports were taken from a variety of knowledgeable sources. Information concerning the cost of Soviet transports was derived from the prices that the USSR listed for prospective customers.

Material concerning the flying time and utilization of Soviet transports was obtained by [redacted] analysis [redacted] Life of engines and components as well as the guarantees for the engines and components also was obtained by the analysis of Soviet components and aircraft engines. Overhaul data, life, and utilization of Western aircraft and aircraft engines were obtained from the actual experience of US airlines and the US aircraft industry.

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APPENDIX D

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APPENDIX E

SOURCE REFERENCES

Evaluations, following the classification entry and designated "Eval.," have the following significance:

Source of Information	Information
Doc. - Documentary	1 - Confirmed by other sources
A - Completely reliable	2 - Probably true
B - Usually reliable	3 - Possibly true
C - Fairly reliable	4 - Doubtful
D - Not usually reliable	5 - Probably false
E - Not reliable	6 - Cannot be judged
F - Cannot be judged	

"Documentary" refers to original documents of foreign governments and organizations; copies or translations of such documents by a staff officer; or information extracted from such documents by a staff officer, all of which may carry the field evaluation "Documentary."

Evaluations not otherwise designated are those appearing on the cited document; those designated "RR" are by the author of this report. No "RR" evaluation is given when the author agrees with the evaluation on the cited document.

Except for CIA finished intelligence, all sources are evaluated RR 2.

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1. [illegible]

2.

3. Ibid.

4. State. CA-10078, 10 May 61, p. 3. OFF USE.
5. Ibid.
6. "
7.
8. State. CA-10078, 10 May 61, p. 3-4. OFF USE.
9. Ibid.
10. Ibid.
11. Ibid.
12. Ibid.
13. Air Transport Association of America. Memo dated 18 May 61. U.
14. CIA. [illegible] Jul 61, p. 3.
15. Ibid.
16. "
17. State, Cairo. T 2011, 13 Jun 61. C.
18. State (Outgoing to Bamako), 225, 30 Mar 61. C.
19.
20.
21. CIA. MCB no 61-28, 6 Jul 61, p. 3. S.
22. Ibid., p. 13. S.
23. Ibid.
24. State. G-148, 2 Mar 60. C.
25. State. G-192, 22 Jun 61. OFF USE.
26. CIA. MCB no 61-28, 6 Jul 61, p. 3.